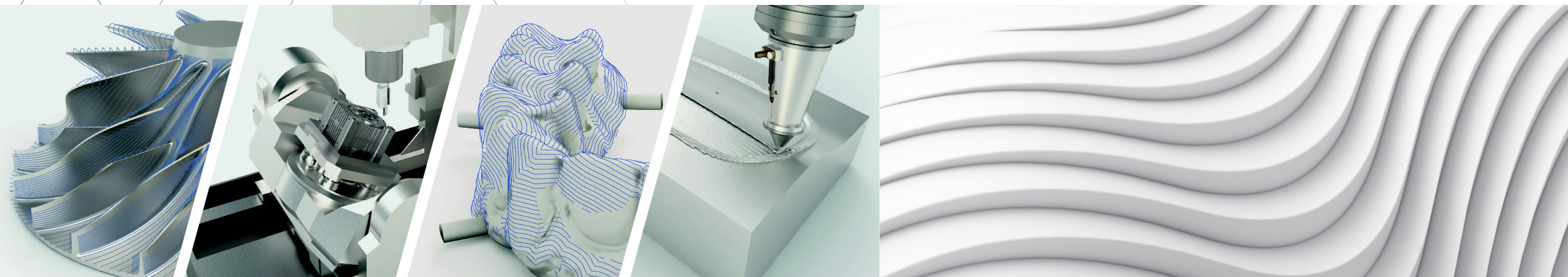


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ModuleWorks

Get There Faster.



Advancements in Development for Toolpath for Production and Mold&Die Machining

Niren Deshmukh and Dr.-Ing. Christian Klingelhöller



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Product Manager

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Klingelhöller

Product Manager

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om

Agenda

- Innovation and Value Creation
 - Components to Modules
 - Modules to Dedicated Applications
- Advancements in Developments for Toolpath for
 - Production Machining
 - Mold & Die Machining
- Process Optimizer

The
Future is
now.

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ModuleWorks

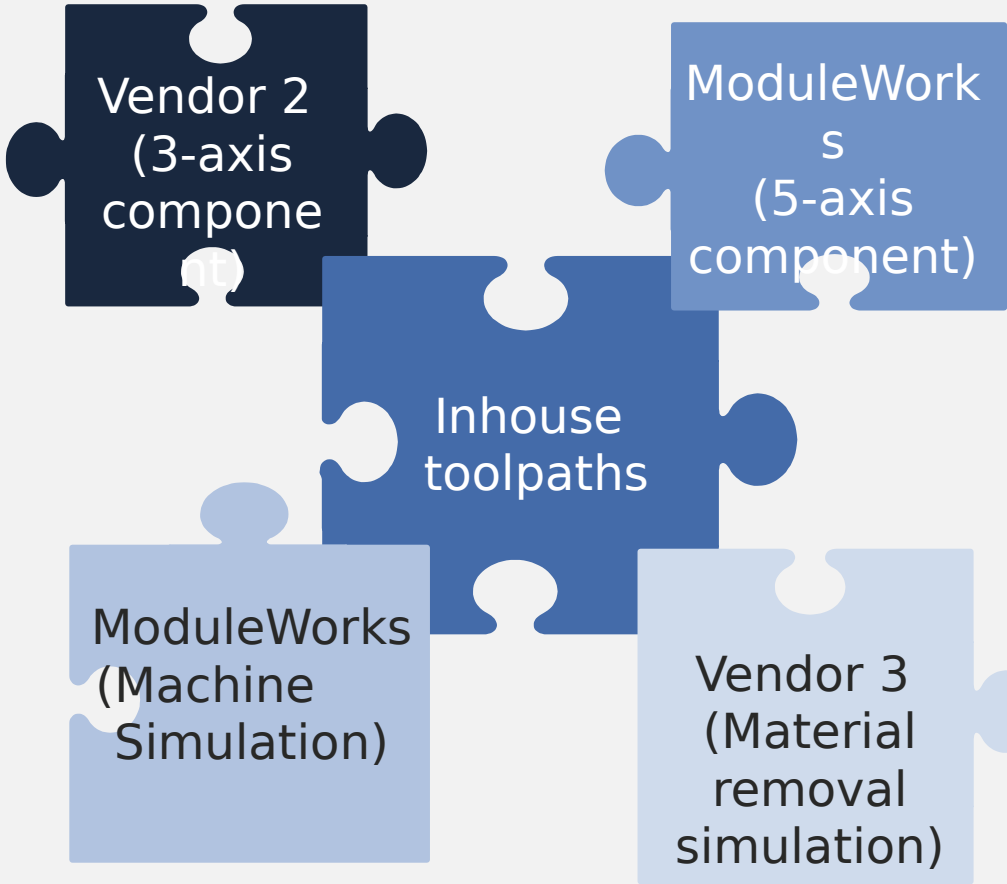
Get There Faster.

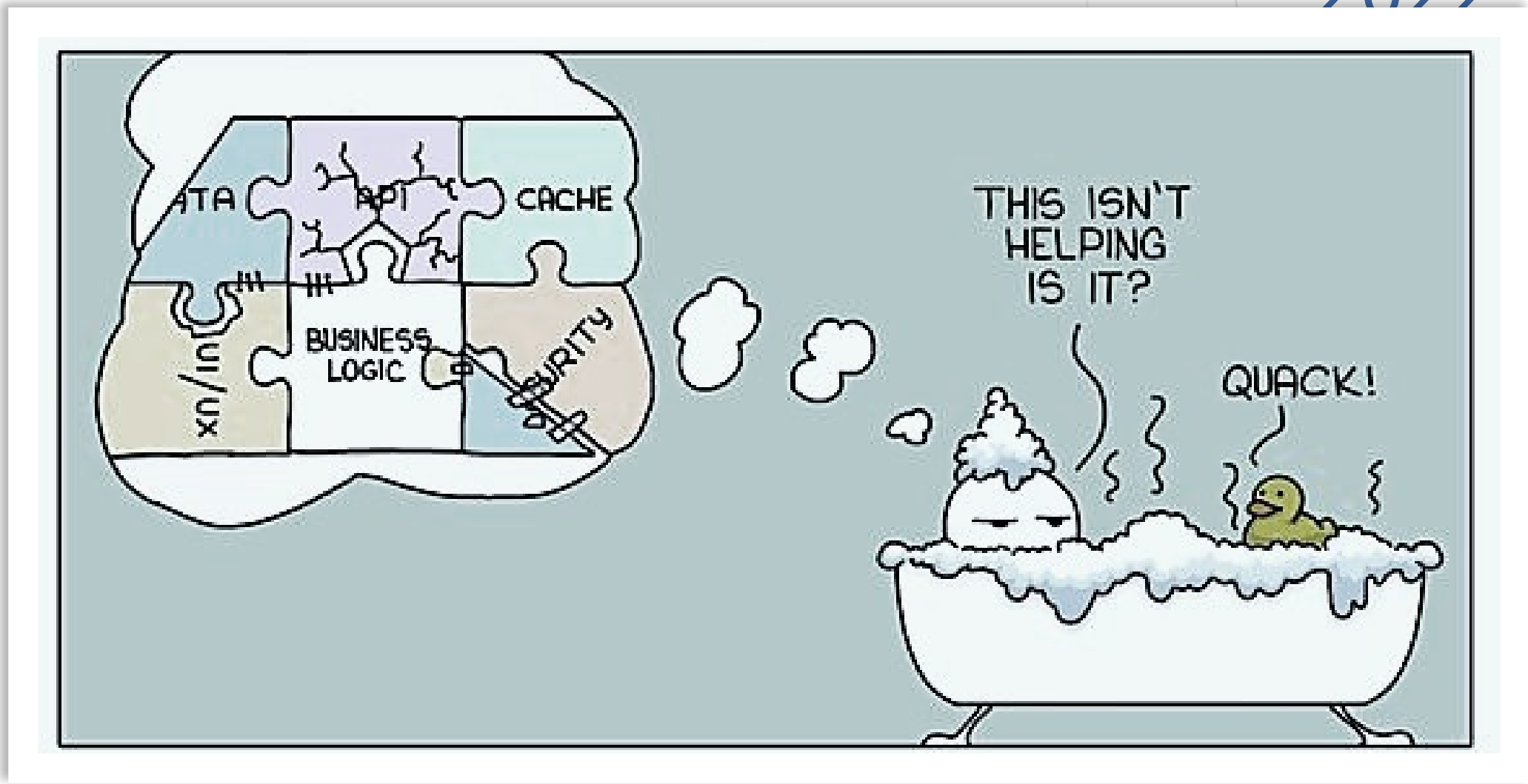
OEM Product Complexity

LEGO + Meccano + Fisher Technik + Ministe



OEM Product

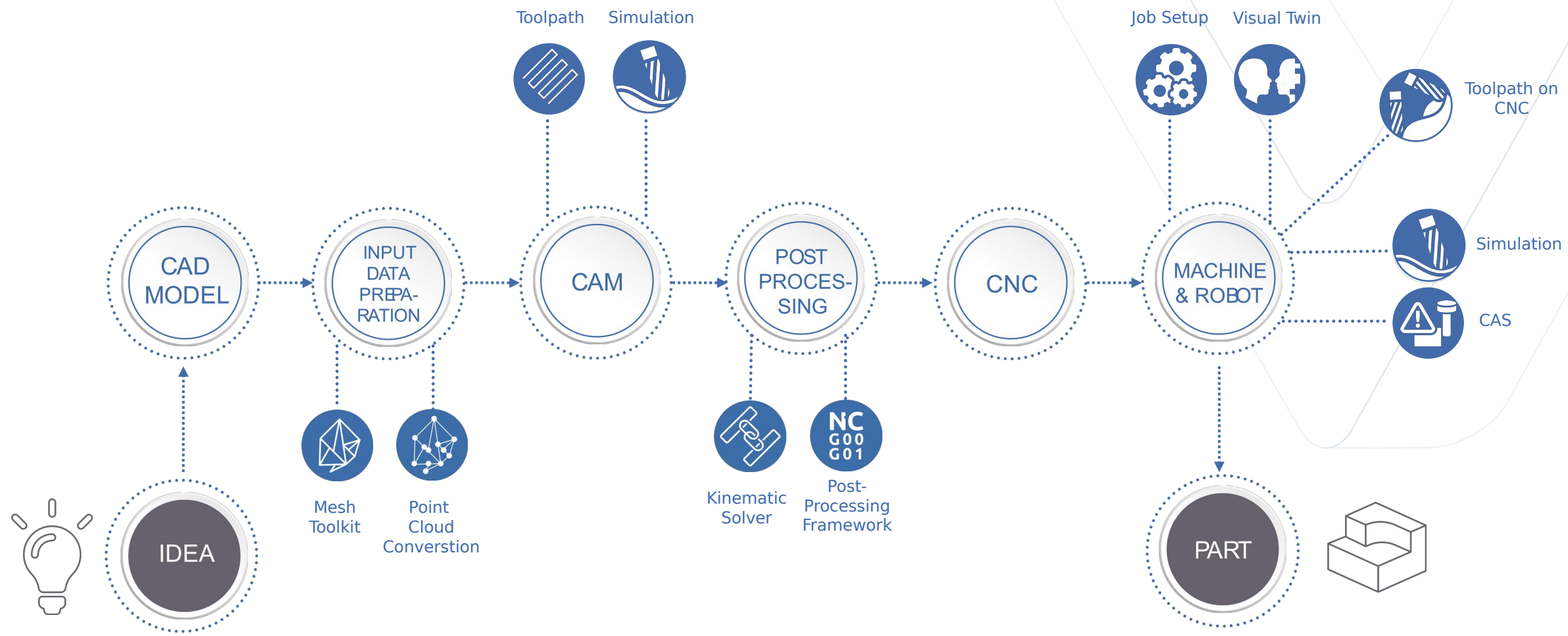




ModuleWorks Components



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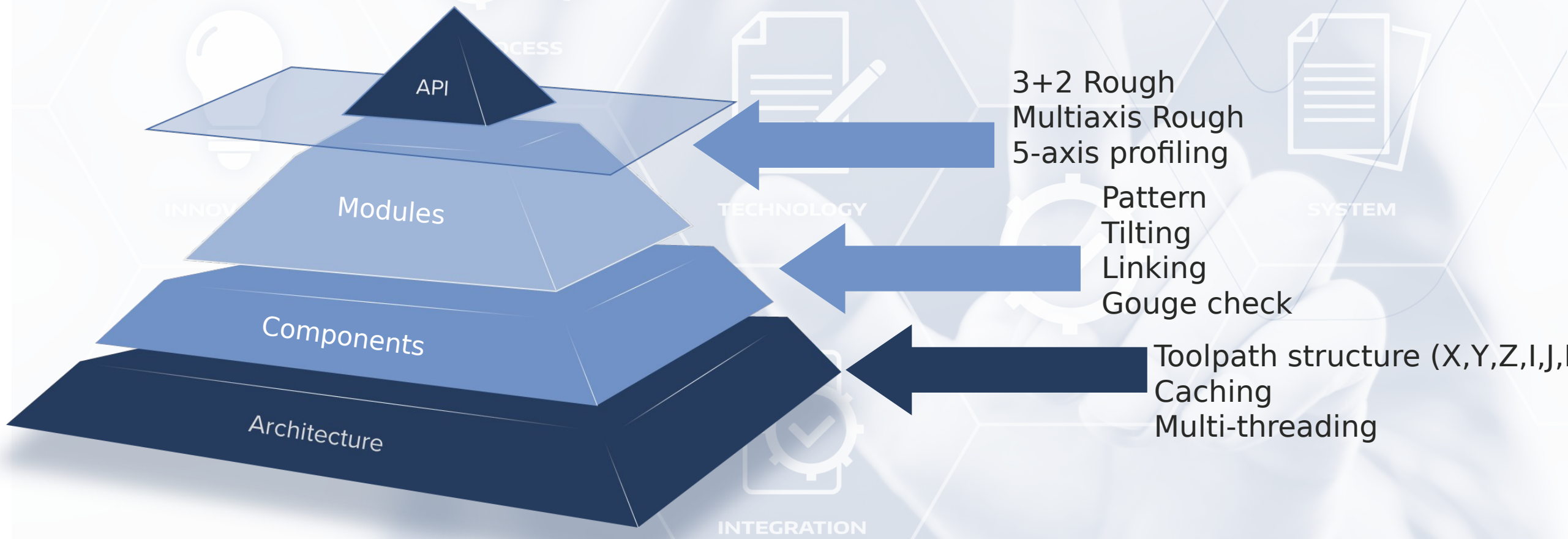


Component and Product Engineering

Domain Engineering	Problem Space		Solution Space
 Stakeholder needs	Variability in Applications and Industries		 Components
Application Engineering	 New requirements		
 Customer needs	Specification of product / Feature selection	 Product development	 Product



AUTOMATION



Modules to Dedicated Apps



Successful experience for users on all knowledge levels by ...

- ... guided product tours
- ... robust solutions
- ... intermediate feedback



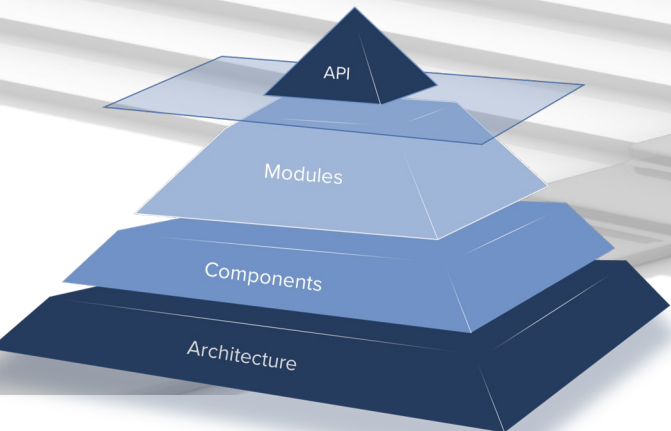
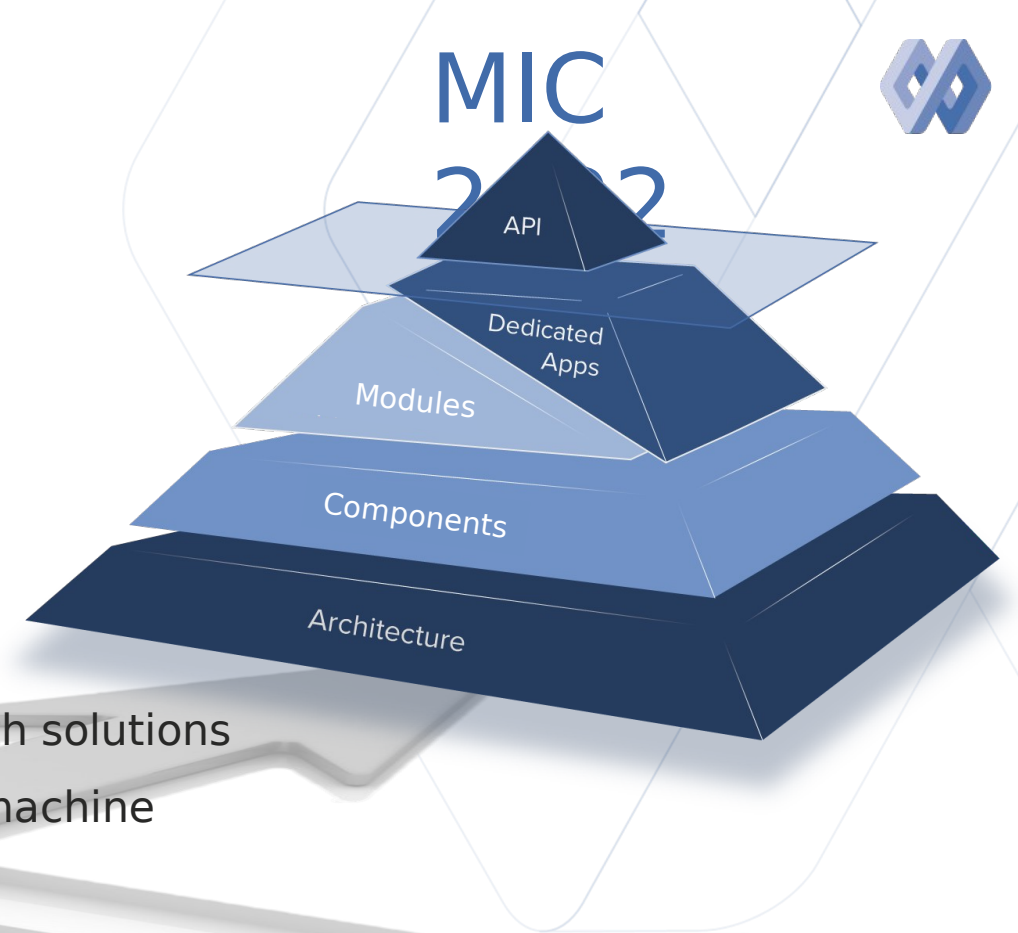
Technology fit by ...

- ... application specific toolpath solutions
- ... consideration of tool and machine characteristics
- ... alignment to technology conventions



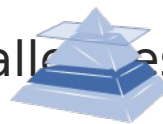
Minimal programming time by ...

- ... faster calculation
- ... predictable results
- ... avoidance of manual re-work (auxiliary geometries, toolpath modifications etc.)



Automatic Tilting Learns to Tilt More than just Sphere Mills

A general technology as enabler for various challenges



Enhanced automatic orientation finding!

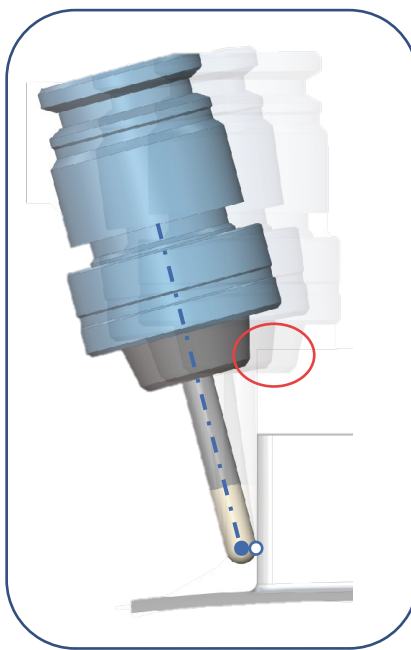


- **Stable Tilt** for less machine movement or
- **Stable Side Tilt** for constant engagement conditions
- Limit **Tilt Rate** to match machine capabilities

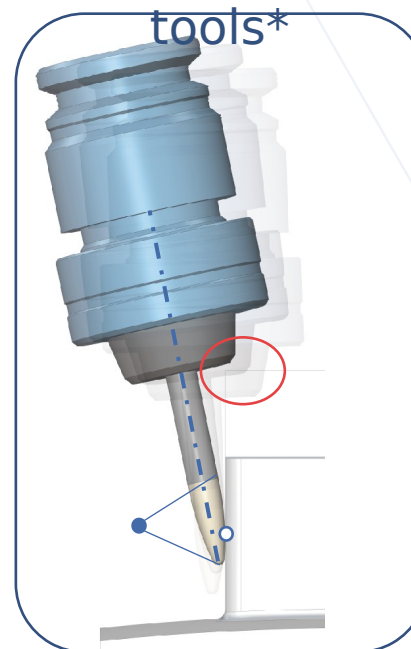
Tool support

contact point information required

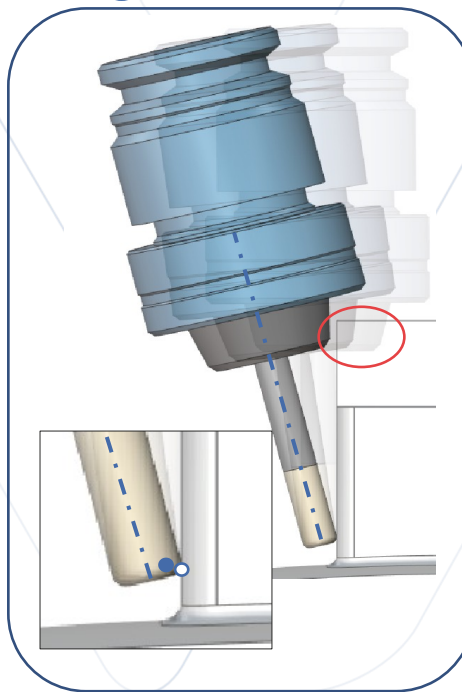
Spherical tool



Barrel tools*



Bull nose* (WIP)



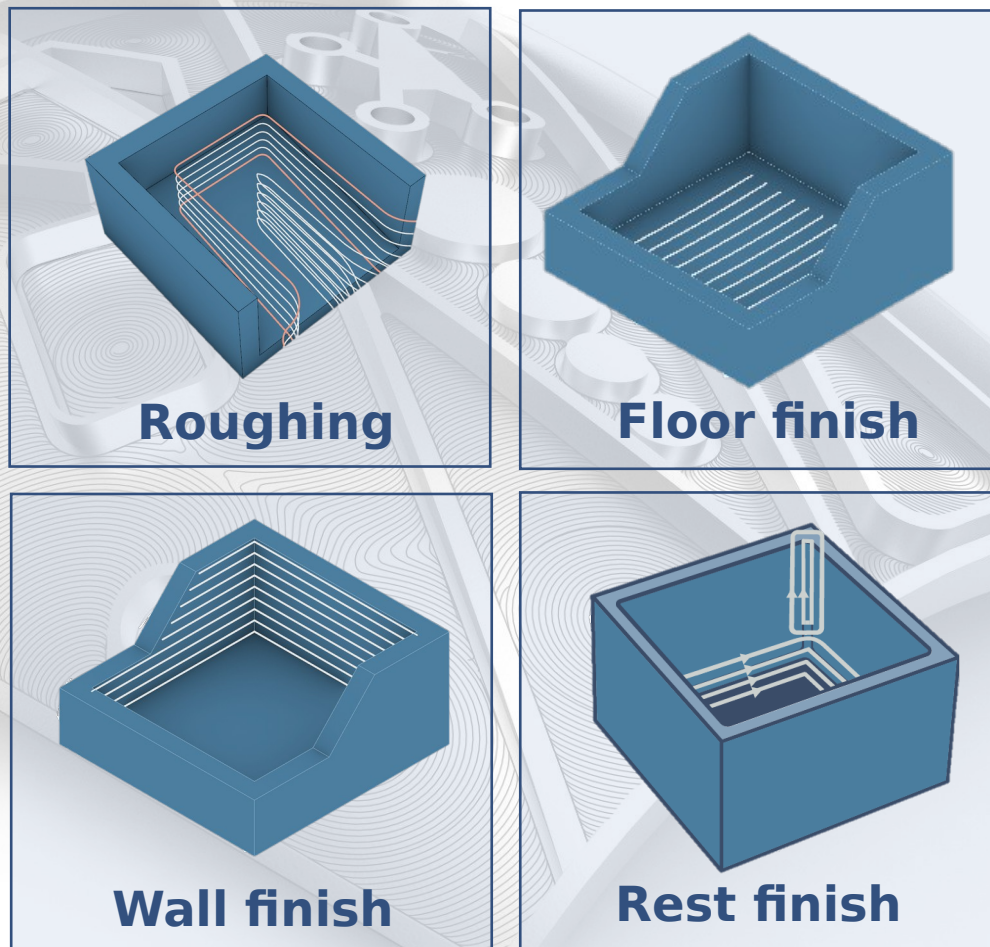
Today

MultiAxisMachining - Machining of Pocket Shaped Features

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An example for customization of general components for a specific feature family

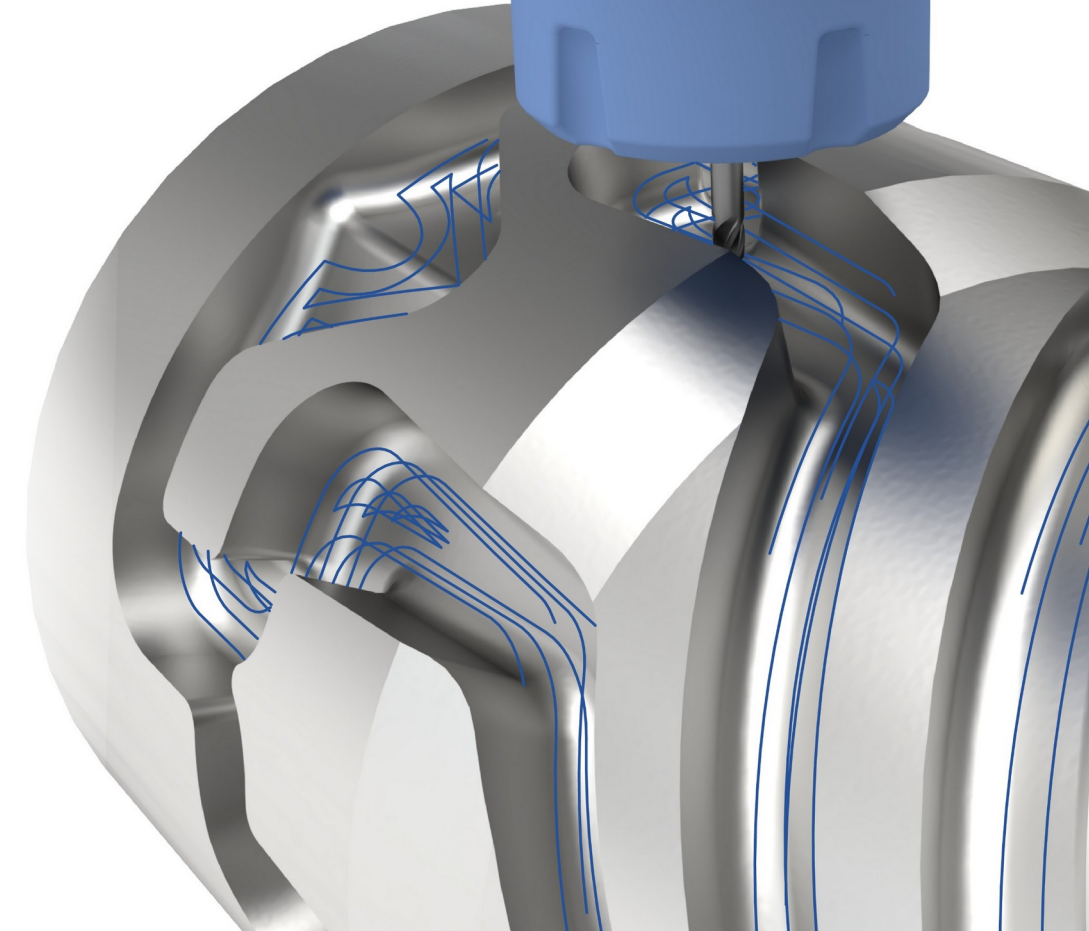


What makes it different?

- Lean, unified and continuous programming workflow
- General tool orientation and ordering automatically derived from feature alignment
- Specific tool orientation settings simplify optimal tool engagement (e.g. for barrel tools)
- Length optimized linking
- Automatic collision checking



Rotary Machining - Safe and Simple 4-Axis Roughing and Finishing

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2022

A combination of 4-Axis specific slicing and established pattern creation engines

Challenges you don't have to worry about:

- Geometry definition
- Patterns that exceed 360°
- Tool orientation incl. Axis offset
- Process specific linking
- Stock aware machining





Deburring Makes Manual Edge Break Obsolete

A highly specialized solution and only toolpath that gouges with the part intendedly (... on the edges)

5-Axis Profiling Deburring



User Interaction

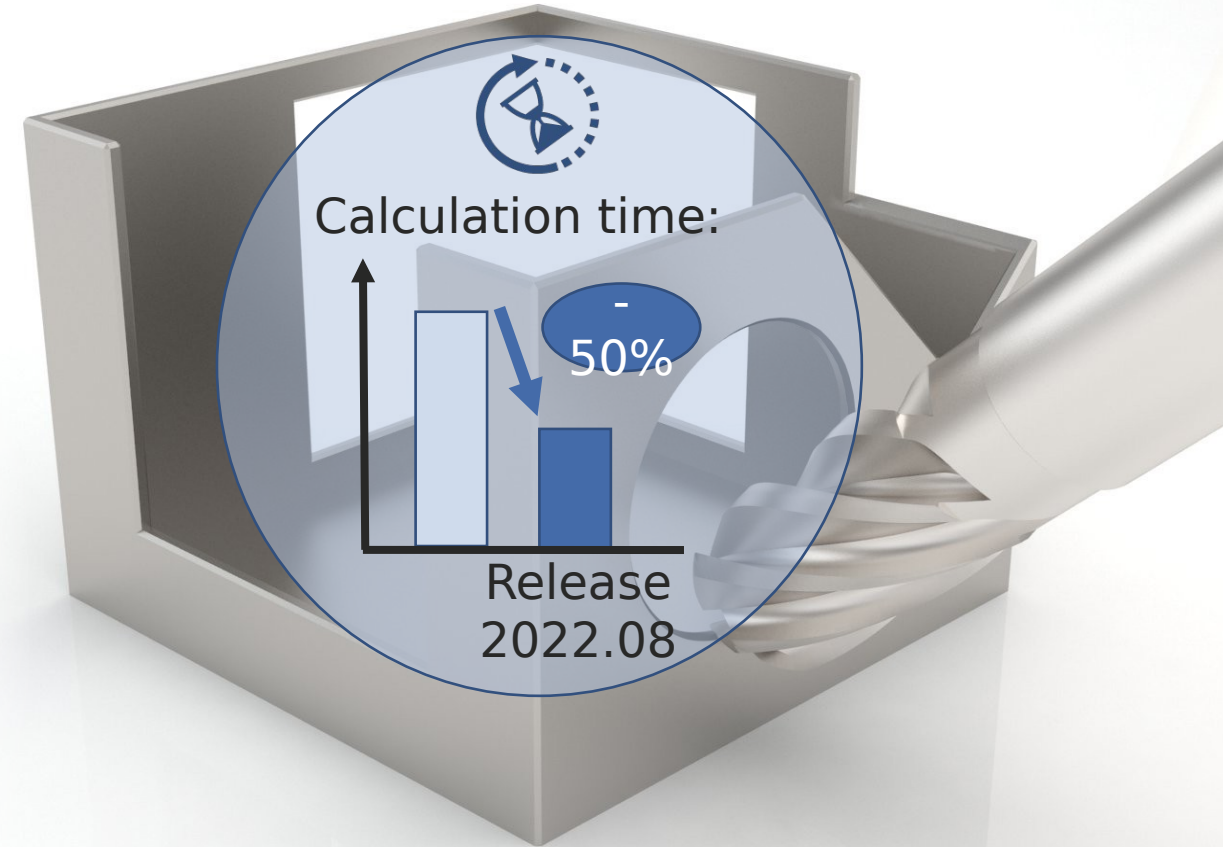
- Manual edge selection
- Manual tip shift
- Manual tool axis definition
- Single cut with constant offset to egde

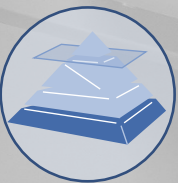
- Part selection



- Edge angle dependent cutting depth
- Shaped multi cuts
- Accurate gouge checking

Technology Fit

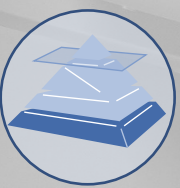




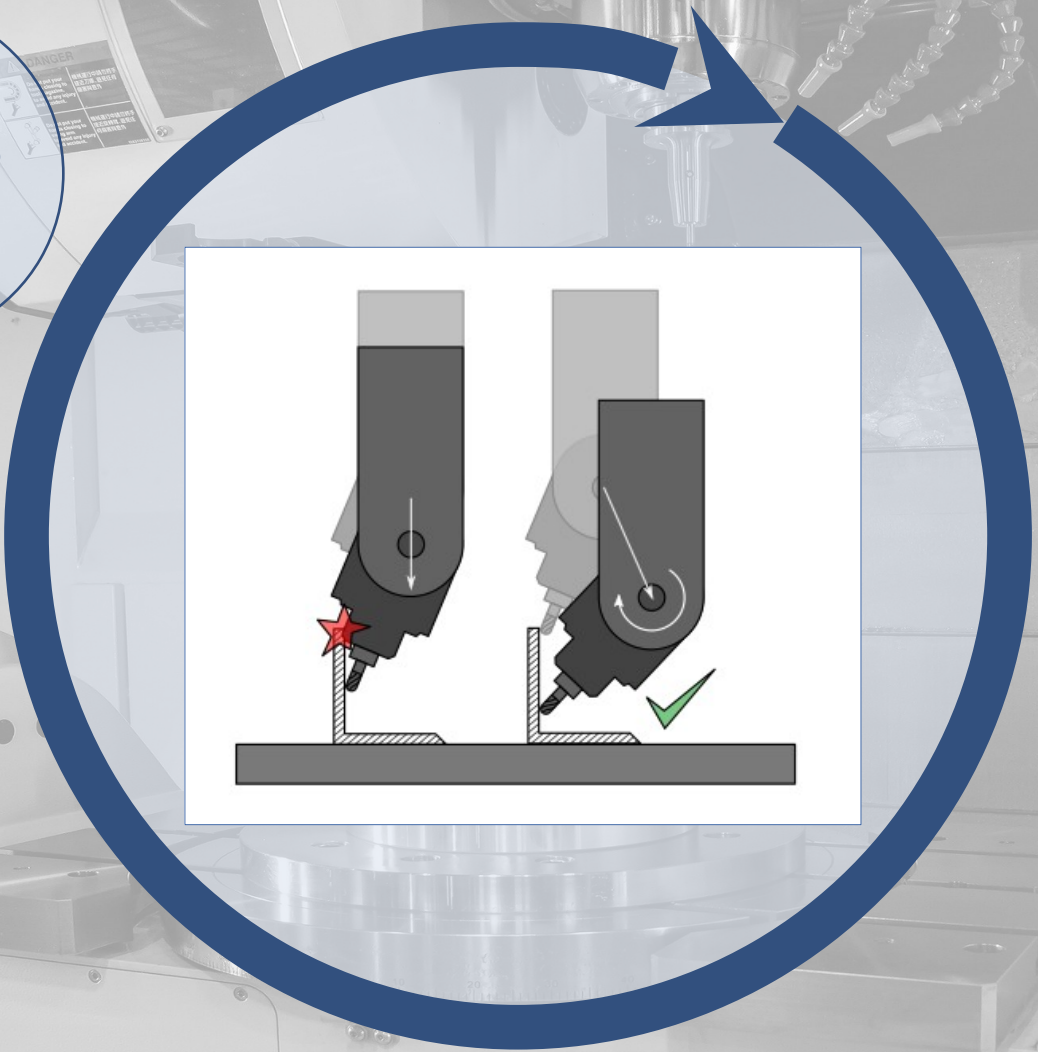
**Tool path
calculation in a
closed loop**
by
embedding
(customer) kinematic
solver

and
embedding simulation





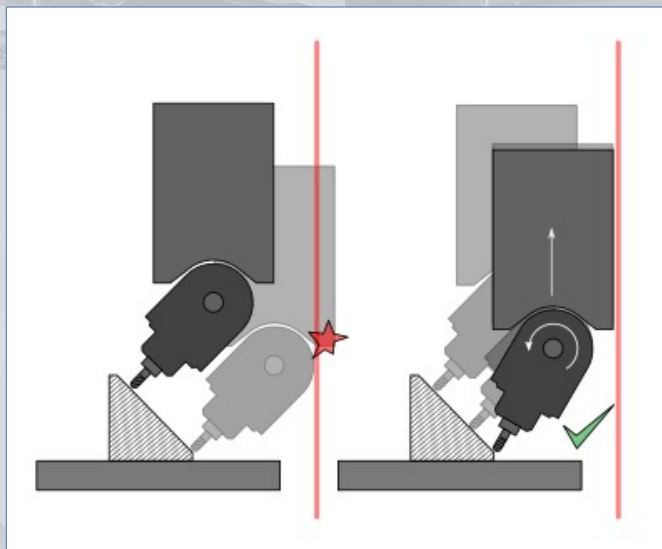
Avoid collisions with machine



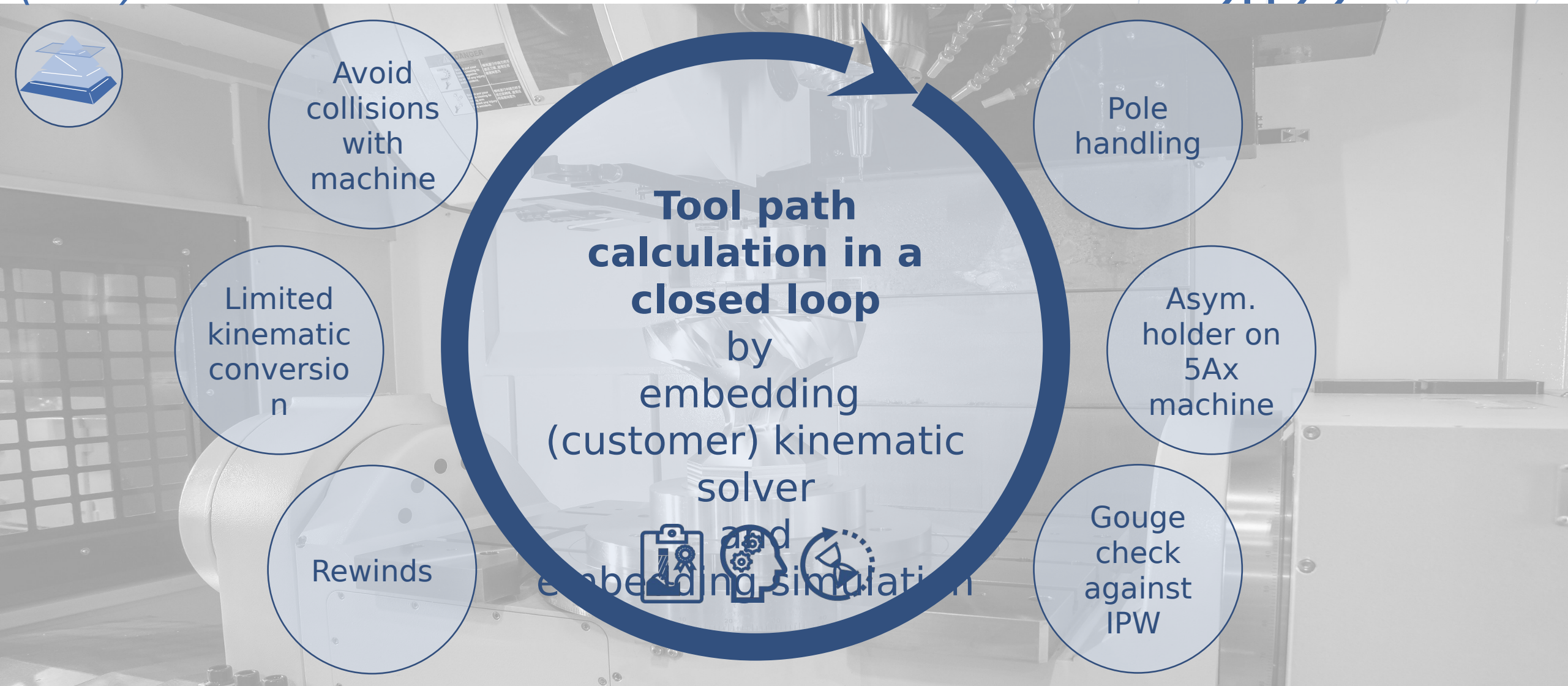


Avoid
collisions
with
machine

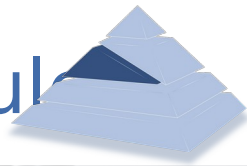
Limited
kinematic
conversion



Machine/Simulation Awareness to reduce iterations MIC (WIP) 2022



3+2-Axis Roughing Module

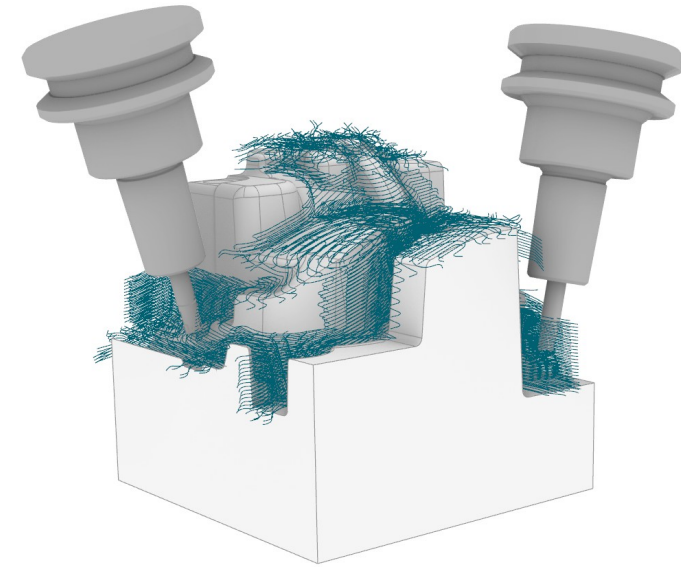


3+2-axis roughing module successfully integrate various software components to create an automated solution for machining of Die and Mold and sculptured parts using indexed positions.



- 5-axis direction finder to calculate indexed positions
- 3-axis toolpath component
- Cutsim verifier engine to update the in-process stock
- 5-axis Linker module is used to create collision free links between indexed positions

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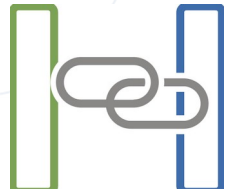
5-axis
Directi
on
Finder



3-axis
Toolpat
h

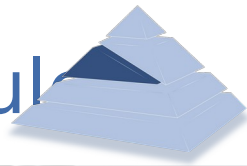


Cutsim
Simulat
ion for
IPW



5-axis
Linker

3+2-Axis Roughing Module



Advantages for End Users

- Programming time slashed by upto 80%
- Machining time reduces by 20-40%



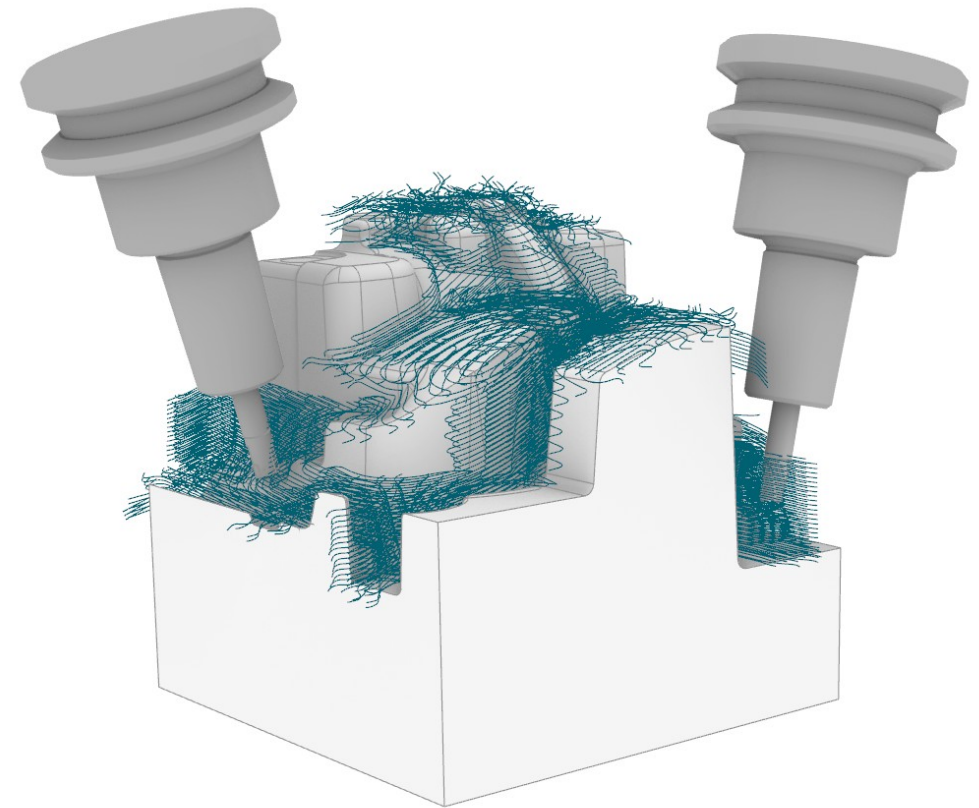
Advantages for Integrators

- Easy to integrate in a host CAD environment
- Faster time to market.

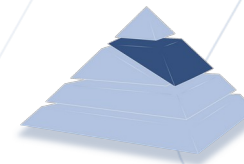


Future development 3+2-Axis Roughing – Prismatic mode

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Dedicated App 5-Axis Die and Mold Package (WIP)



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2022



Goal

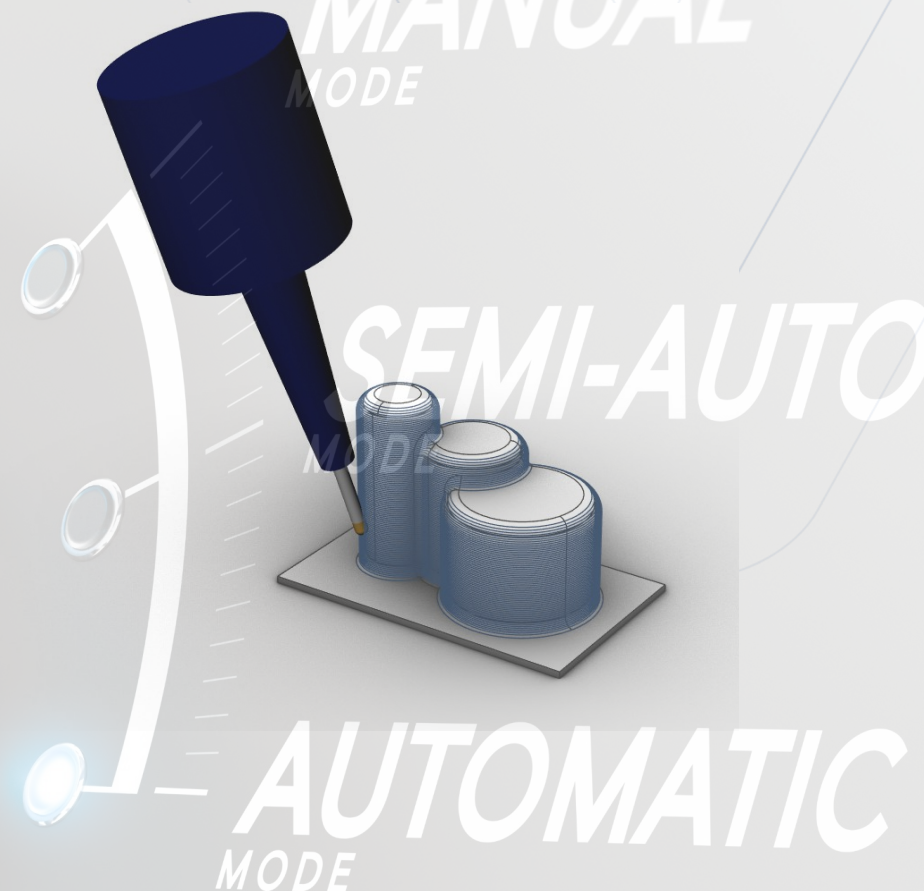
Dedicated application to simplify 5-axis programming of Mold & Die parts



Automation to provide successful experience for users on all knowledge levels



Parameter optimization to provide robust and predictable gouge free toolpaths



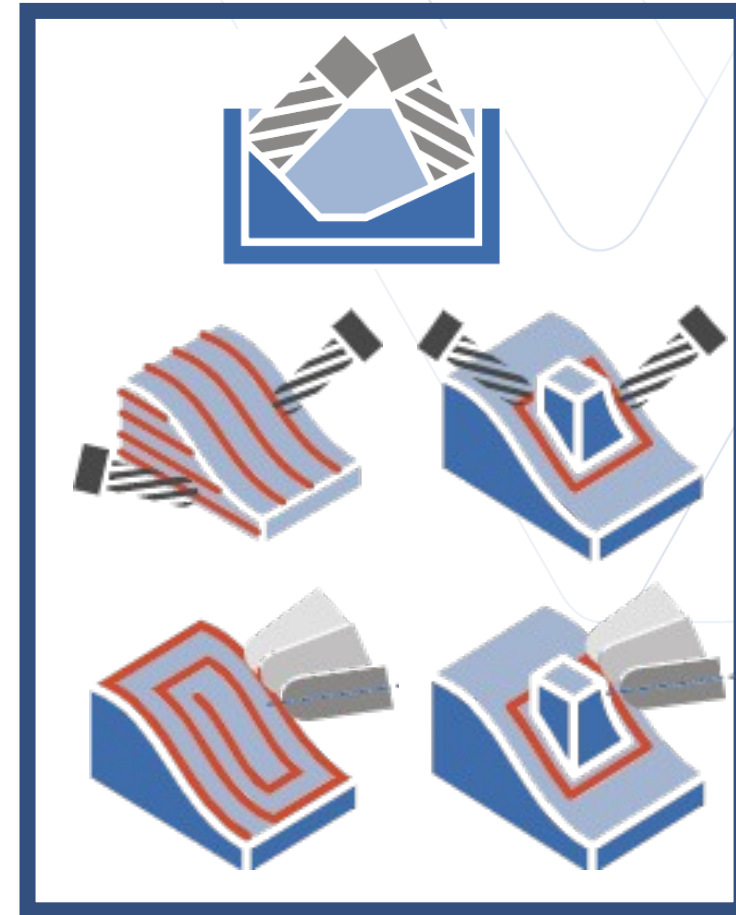
Dedicated App 5-Axis Die and Mold Package (WIP)

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Strategies

- 3+2-axis rough
- 3+2-axis finish
- 3+2-axis rest finish
- 5-axis finish
- 5-axis rest finish



Dedicated App 5-Axis Die and Mold Package (WIP)

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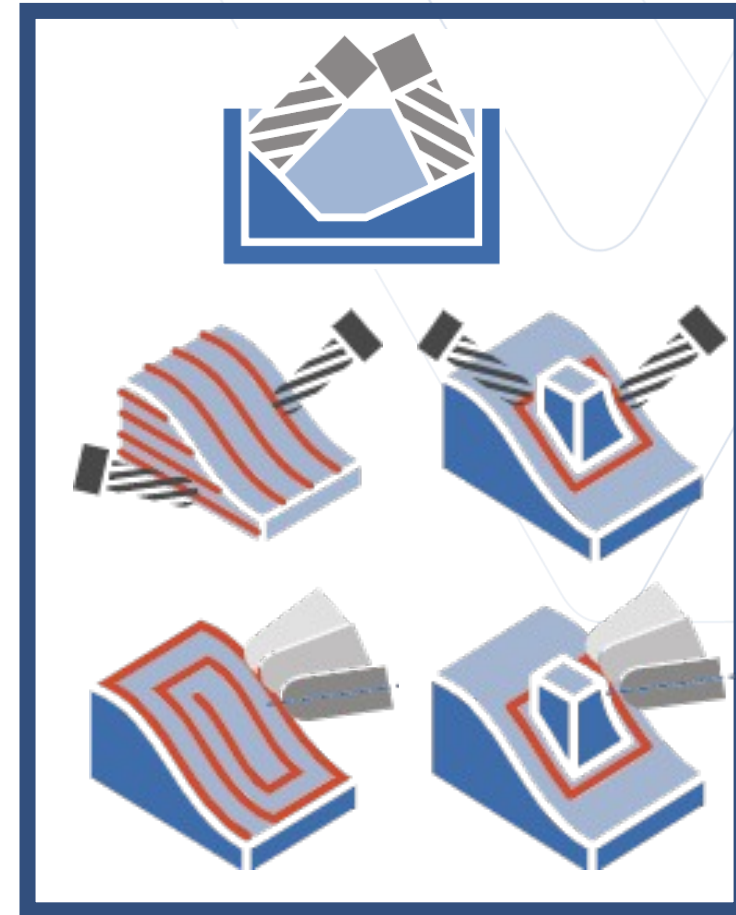
Advantages for End Users

- Automated, easy to use
- Robust collision free, safe toolpaths
- High surface quality
- Reduced programming time
- Reduced machining time
- Reduced setup time



Advantages for Integrators

- Easy to integrate in a host CAD environment
- Faster time to market.
- Lesser training effort



Process Optimizer Module (WIP)



Goal

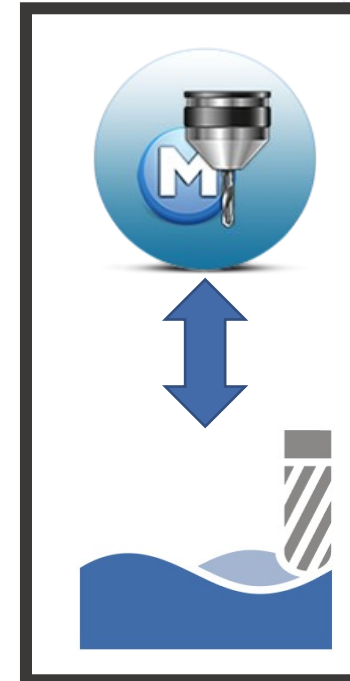
Automatically optimize and improve process critical parameters (Depth step, Stepover, Speed, Feed) prior to actual machining



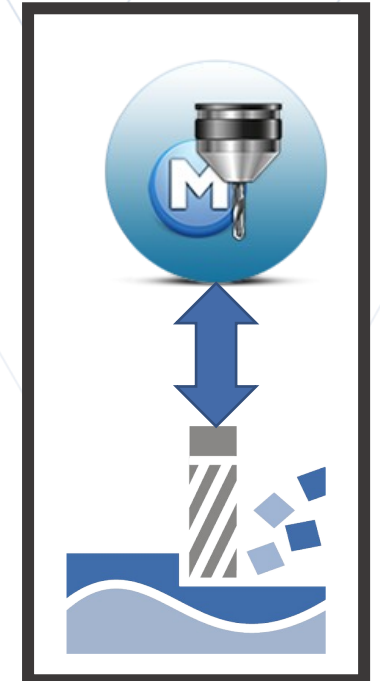
Developed in collaboration with **Manufacturing Automation Laboratories Inc.**(MAL) developers of advanced physics-based process simulation and NC program optimization software

MIC 2022

MAL Physic
engine – CAM
interface



MAL
Feedrate /
Spindle speed
optimization





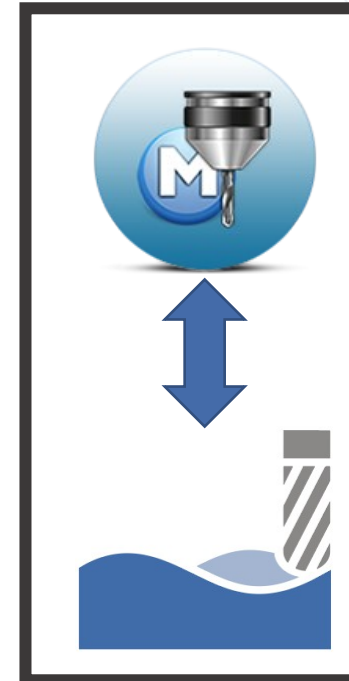
Technology

1) Pre-Process Optimization

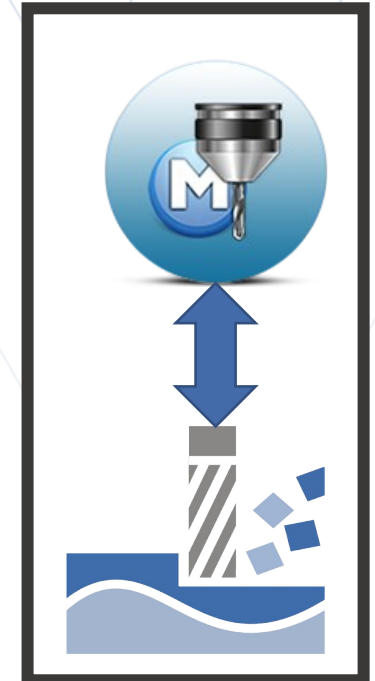
Physics based engine accurately selects appropriate depths and widths of cut, spindle speeds, feeds based on following constrains

- Material removal rate
- Cutting forces
- Chip thickness
- Vibration amplitudes and frequencies
- Spindle power and torque
- Bending moment

MAL Physic
engine – CAM
interface



MAL
Feedrate /
Spindle speed
optimization



MIC
2022

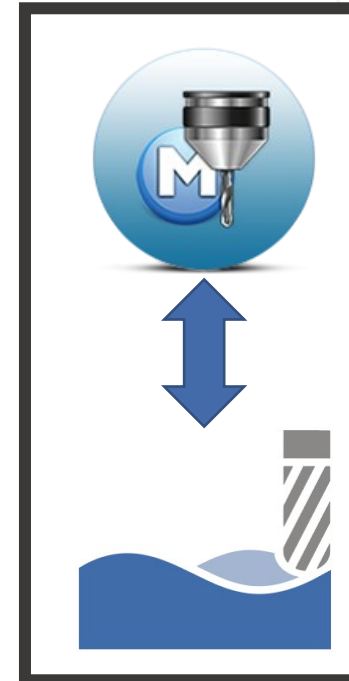
Technology

2) Post-Process Optimization

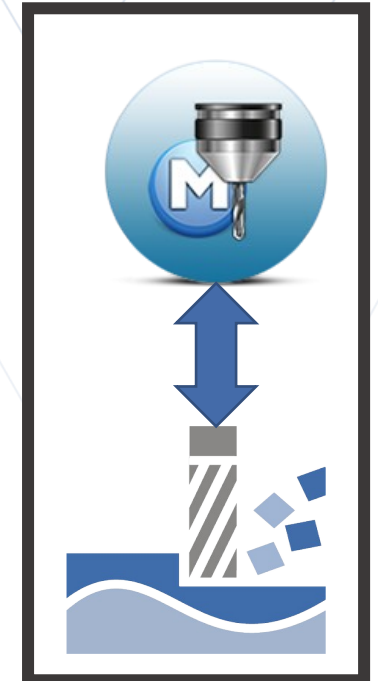
Physics based process simulation is used for Feed rate optimization based on following constrains

- Chatter
- Spindle Torque/Power
- Cutting Load
- Vibrations
- Chip Thickness
- Tool Bending Forces

MAL Physic
engine – CAM
interface



MAL
Feedrate /
Spindle speed
optimization



Process Optimizer Module (WIP)

MIC



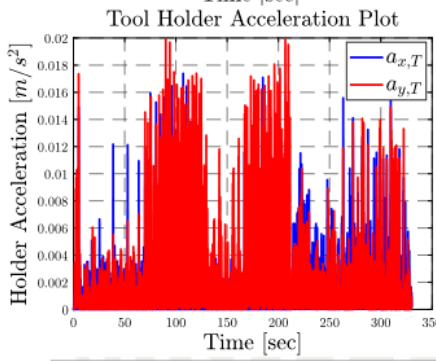
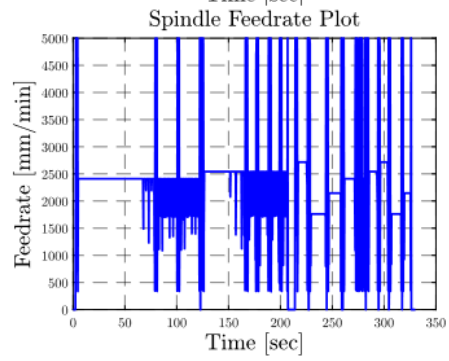
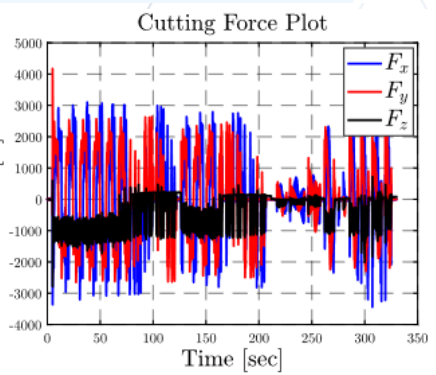
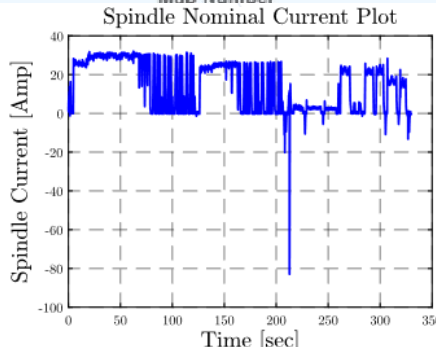
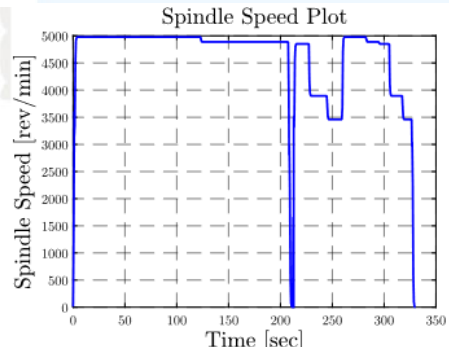
Doruk Merdol, PhD
MAL Manufacturing Automation Laboratories, Inc.
The University of British Columbia



Initial machining trails at University of British Columbia

Advantages :

- Reduced machining time
- Higher material removal rates
- Constant chip thickness
- Stable machining conditions
- Better tool and spindle life

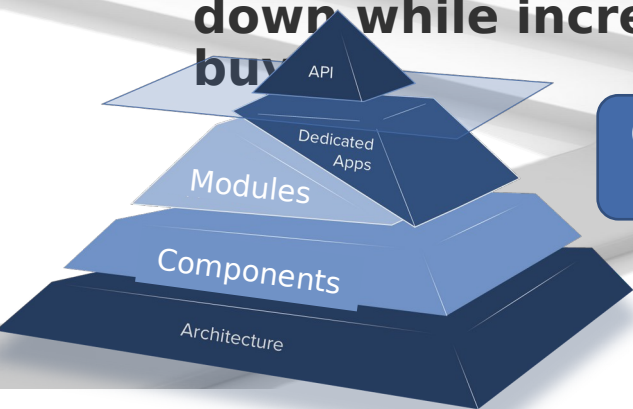


Value Innovation

By introducing advanced technologies, new modules and dedicated apps, Moduleworks would like to increase the value innovation.

Advantages :

- Reduce integration cost and effort
- Incorporate successful innovations quickly
- Improve time to market and provide competitive advantage
- **In simple terms, bringing the cost down while increasing value**



Components

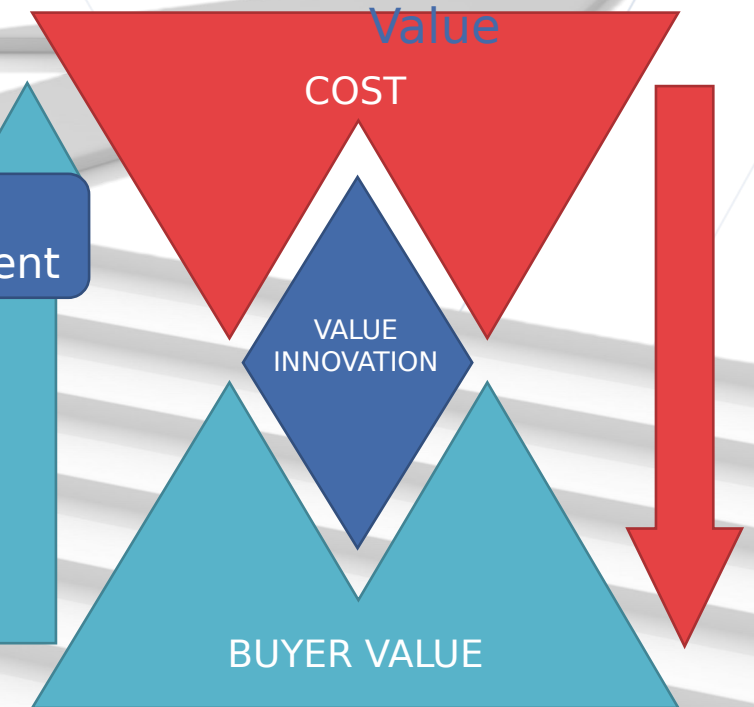
Modules

Dedicated Apps

Co-development

ModuleWorks

Get There Faster.





Thank you for your attention



ModuleWorks

Get There Faster.

www.moduleworks.com
info@moduleworks.com

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